

Appendix A

Coastal Bluff Stabilization and Construction Issues in the LOSSAN Corridor

SLOPE STABILITY

Failure of adjacent natural slopes and/or construction cut slopes or retention structures is a concern in the Del Mar and San Clemente areas of the LOSSAN Corridor conventional rail alternatives. The following is a general discussion of areas along the proposed corridor identified as unstable (specifically, the trench alternatives along the beach/coastal bluffs in Del Mar and San Clemente), and potential measures that would have to be considered in order to achieve long-term stability of the proposed rail corridor improvements (Leighton & Associates 2003).

Existing Stabilization Methods

A number of remedial or stabilization measures exist along the existing railway in the vicinity of the proposed rail corridor improvements. These include older improvements along the coastal bluff face through the cities of Del Mar and San Clemente that are in need of ongoing repair and or maintenance. For example, in Del Mar, wooden and concrete seawalls along portions of the bluff are currently protecting portions of the base of the bluff against erosion due to typical wave impact. However, these walls are occasionally of insufficient height to block heavy storm surf or at least require periodic maintenance to remain effective. In San Clemente, the existing rip-rap berms also requires maintenance.

Other facilities that need ongoing maintenance include the storm drain and subdrain facilities along the bluffs in Del Mar and San Clemente. These include engineered but undersized facilities, drains rendered inoperable due to lack of maintenance, and un-engineered facilities, commonly temporary in nature, such as those installed by property owners upslope of the bluffs in San Clemente. In several locations, these drains were observed to be leaking and causing surface erosion and infiltration of water into the underlying soils.

Such existing conditions must be taken into account even where relatively minor construction is proposed as part of a given rail corridor improvement. Potential slope reinforcement and protection measures that may be needed are discussed below.

Stabilization of Bluff Toes

In areas where increased erosion could result in significant damage (i.e., erodible materials, such as compacted fill soils), stabilization at the bluff toe should be considered. Stabilization measures at the bluff toe can serve to preserve or increase lateral support. Methods for stabilization include wooden and concrete sea walls, steel piles and wood lagging walls, sand cement revetment, rock revetments, and beach replenishment. Details for sea wall construction, rock revetment details, and beach replenishment, are beyond the scope of this report, but are discussed in a site specific report on the Del Mar Bluffs (Leighton, 2001a).

Stabilization of Bluff Faces

In areas where the erosion or failure of the existing seacliff would impact the proposed rail alignment by undermining the foundation or by deposition of debris from upslope areas, stabilization of the bluff face must be considered. Slope grading can be performed to stabilize the bluff and re-establish eroded and failed areas, as was done previously at several locations along the coastal rail route through San Clemente and Del Mar (Leighton & Associates 2003).

Where sufficient railway right-of-way is available, slope grading would generally consist of the placement of compacted fill soils on the face of the slope to provide additional lateral support, flatten localized over-steepened areas, and allow for the removal of existing slope failures. Typical grading would start by establishing a key at the base of the area to be filled that extends into competent material. A subdrain could be placed at the back of the key to minimize future groundwater accumulation and at selected higher elevations during the site grading. A typical fill slope would be constructed at a 2 to 1 (horizontal to vertical) inclination with compacted fill soils. With some of the constraints of the site, steeper slopes may be desirable in order to maintain existing beach widths or to minimize grading. Steeper slopes can be constructed by the incorporation of geogrid reinforcement into the compacted fill soils or by the use of a soil-cement mixture.

Other mitigative measures for improving surficial slope stability are available in confined property areas requiring steeper as-built facilities. These include sand-cement buttresses, pipe and board retaining walls, and veneered tie back walls.

Stabilization of Bluff Tops

Where the tracks are located up-slope, without adequate setback from an unstable bluff face, or where further erosion would reduce this setback to an unreasonable distance, additional bluff top stabilization would be needed. Where other concerns preclude disturbance outside the right of way, stabilization of the tracks from the bluff top may be desirable. A series of soldier piles may be considered for support of the track bed. Soldier piles generally consist of a series of concrete encased I-Beams placed in a row adjacent to the track. They may be used in conjunction with tie-backs as a versatile stabilization method (Leighton, 2001a). The tie-back system may also be utilized for the repair of over-steepened portions of the bluff. If a tie-back system is proposed on the bluff face, architectural wall facing could be sculpted with colored concrete to afford the wall a natural appearance.

Drainage Improvements

Drainage over coastal bluffs occurs by both sheet flow and by earthen swales. Standing water observed along isolated areas adjacent to the existing rail alignments appears to be a combination of surface runoff and groundwater seepage that is generated by irrigation of upslope properties, and blocked by debris and soil creating localized areas of ponding. In other areas storm drains and subdrain outlets discharge on or near the top of slope creating an influx of water and increasing erosion. Some of the storm drain outlets leak and are in need of repair, and others simply discharge directly at the top of bluff. Improvements have already been made in some areas along coastal San Clemente; however, existing subdrains or stormdrains can be under-designed. Any proposed subsurface drainage system should be finalized after additional evaluation of possible water sources and depths.

Groundwater Reduction

Subsurface drainage is a major problem along coastal bluffs and a reduction of subsurface water would greatly improve the geotechnical conditions. The source of the water includes infiltration from surface runoff, but the majority of the water comes from other influences upslope which likely cannot be controlled or eliminated. These sources include surface sources that may be collected and directed to the storm drain system but the majority of the water is likely the result of upslope infiltration of irrigation and storm water. The water flows as perched water through the relatively permeable surficial geologic units that overlie the formational materials below and as localized seepage zones within the formation where sandy zones or fracture systems are present. Specific dewatering methods, including installation of subdrains, dewatering wells, and horizontal drains, slurry walls, cut off walls and soil mixing of saturated zones should be addressed in site-specific design studies. The selection of a preferred dewatering method should be based in part on additional site investigations and ground water modeling.

SEA LEVEL RISE

Global warming and rising sea levels have become a growing concern as a coastal hazard. Current projections estimate that a rise in sea levels of 19 inches could occur by the year 2100 (with a possible range of 5 to 37 inches). The slope stability issues in the coastal bluff areas in Del Mar and San Clemente described above would be exacerbated in the future by rising water levels and storm surges. Such conditions would have a direct impact on beach erosion and on storm-protection and stabilization structures along the rail infrastructure on the coastline.

Table 4.0
Analysis/Comparison Table
Impacts to Cultural Resources
Los Angeles – Orange County – San Diego Region

For each of the four locations in which screening recommendations are being made (San Juan Capistrano, San Clemente/Dana Point, Encinitas, and Del Mar), Table 4-0 shows the number of known archaeological sites located near each alignment option; the percentage (based on miles) of each alternative route that passes through areas originally developed during historical time periods; whether or not “traditional cultural properties” (sites that have some demonstrated importance to the local Native American community) are present; and lastly, an overall ranking of the potential sensitivity of the alignment in regard to cultural resources.

	Number of Archaeo- logical Sites	Percentage of Route Developed During Historic Periods			Traditional Cultural Properties (Yes/No)	Overall Ranking (High, Medium, Low)
		<1900	1900-1929	1930-1958		
Alignments						
San Juan Capistrano – (San Juan Capistrano City Limits to Avenida Aeropuerto) – Covered TRENCH/Cut-Fill between Trabuco Creek and Avenida Aeropuerto (trench goes under San Juan Creek); Double tracking	19	10.5	15.0	20.5	0	High
San Juan Capistrano (San Juan Capistrano City Limits to Avenida Aeropuerto) – TUNNEL along I-5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking	8	1.0	15.0	20.5	0	Medium
San Juan Capistrano (San Juan Capistrano City Limits to Avenida Aeropuerto) AT-Grade/Open TRENCH along east side of Trabuco Creek	2	1.0	15.0	20.5	0	High
Stations						
San Juan Capistrano Station – parking spaces OR parking spaces/bypass tracks	6	10.0	45.5	25.0	0	High
Alignments						

	Number of Archaeo- logical Sites	Percentage of Route Developed During Historic Periods			Traditional Cultural Properties (Yes/No)	Overall Ranking (High, Medium, Low)
		<1900	1900-1929	1930-1958		
Dana Point/San Clemente (Avenida Aeropuerto to San Onofre Power Plant) – Dana Point Curve Realignment; San Clemente – SHORT TRENCH; Double Tracking	16	<0.1	2.0	35.5	0	High
Dana Point/San Clemente (Avenida Aeropuerto to San Onofre Power Plant) – Dana Point Curve Realignment; San Clemente – LONG TRENCH; Double Tracking	16	<0.1	2.0	35.5	0	High
Dana Point/San Clemente (Avenida Aeropuerto to San Onofre Power Plant) – Dana Point Curve Realignment; San Clemente – SHORT TUNNEL; Double Tracking	9	<0.1	2.0	36.0	0	Medium
Dana Point/San Clemente (Avenida Aeropuerto to San Onofre Power Plant) ; San Clemente – LONG ONE-SEGMENT TUNNEL; Double Tracking	6	<0.1	2.0	35.5	0	Medium
Dana Point/San Clemente (Avenida Aeropuerto to San Onofre Power Plant) – San Clemente – LONG TWO-SEGMENT TUNNEL; Double Tracking	6	<0.1	2.0	35.5	0	Medium
Stations						
San Clemente Station – parking spaces OR parking spaces/bypass tracks	0	<0.1	25.0	26.5	0	High
Alignments						
Encinitas/Solana Beach Encinitas City Limits To Solana Beach Station – Encinitas – AT-GRADE; Double Tracking; crosses San Elijo Lagoon	4	<0.1	15.5	49.5	0	Medium

	Number of Archaeo- logical Sites	Percentage of Route Developed During Historic Periods			Traditional Cultural Properties (Yes/No)	Overall Ranking (High, Medium, Low)
		<1900	1900-1929	1930-1958		
Encinitas/Solana Beach Encinitas City Limits To Solana Beach Station – Encinitas – SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon	4	<0.1	15.5	49.5	0	Medium
Encinitas/Solana Beach Encinitas City Limits To Solana Beach Station – Encinitas – LONG TRENCH; Double Tracking; crosses San Elijo Lagoon	4	<0.1	15.5	49.5	0	Medium
<i>Stations</i>						
Solana Beach Station – parking spaces OR parking spaces/bypass tracks	0	<0.1	2.0	5.5	0	Medium

	Number of Archaeo- logical Sites	Percentage of Route Developed During Historic Periods			Traditional Cultural Properties (Yes/No)	Overall Ranking (High, Medium, Low)
		<1900	1900-1929	1930-1958		
Alignments						
Del Mar Solana Beach Station To Interstate 5 – COVERED TRENCH on bluffs; crosses San Dieguito Lagoon, Los Peñasquitos L	12	<0.1	5.0	25.5	0	High
Del Mar Solana Beach Station To Interstate 5 – TUNNEL under Camino Del Mar; crosses San Dieguito Lagoon, Los Peñasquitos Lagoon	2	<0.1	5.0	25.5	0	High
Del Mar Solana Beach Station To Interstate 5 – TUNNEL along I-5; crosses San Dieguito Lagoon, Los Peñasquitos Lagoon	8	<0.1	5.0	25.5	0	Medium

TABLE 4-1

**Detailed Analysis/Comparison Table
Impacts to Geology/Soils/Seismicity
Los Angeles - Orange County - San Diego**

Table 4-1 provides an overview of the seismic conditions and geologic and soil characteristics found at each of the four locations where screening recommendations have been made. This overview includes the presence along or near the alternative routes of seismic hazards; fault crossings; percent of length of the alternative alignments with slope stability problems, areas of difficult excavation, and crossing through oil or gas fields; and the presence or absence of mineral resources.

	Seismic Hazards (% of Length)	Active Fault Crossings (No. of Crossings)	Slope Stability (% of Length)	Difficult Excavation (% of Length)	Oil and Gas Fields (% of Length)	Mineral Resources (Present, not present)
San Juan Capistrano (City Limits to Avenida Aeropuerto)						
Alignments						
Covered TRENCH/Cut-Fill between Trabuco Creek and Avenida Aeropuerto (trench goes under San Juan Creek); Double tracking	75	0	0	10	0	0
TUNNEL along I-5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking	26	0	0	10	0	0
AT-Grade/Open TRENCH along east side of Trabuco Creek	0	0	76	0	0	0
Stations						
San Juan Capistrano	Present	0	0	0	0	0

	Seismic Hazards (% of Length)	Active Fault Crossings (No. of Crossings)	Slope Stability (% of Length)	Difficult Excavation (% of Length)	Oil and Gas Fields (% of Length)	Mineral Resources (Present, not present)
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)						
Alignments						
Dana Point Curve Realignment; San Clemente - SHORT TRENCH; Double Tracking (crosses San Mateo and San Onofre Creeks)	27	0	76	9	0	0
Dana Point Curve Realignment; San Clemente - LONG TRENCH; Double Tracking (crosses San Mateo and San Onofre Creeks)	27	0	76	23	0	0
Dana Point Curve Realignment; San Clemente - SHORT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	0	0	0	14	0	0
San Clemente - LONG ONE-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	0	0	0	50	0	0
San Clemente - LONG TWO-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	0	0	0	50	0	0
Stations						
San Clemente	Present	0	0	Present	0	0

	Seismic Hazards (% of Length)	Active Fault Crossings (No. of Crossings)	Slope Stability (% of Length)	Difficult Excavation (% of Length)	Oil and Gas Fields (% of Length)	Mineral Resources (Present, not present)
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)						
Alignments						
Encinitas - AT-GRADE; Double Tracking; crosses San Elijo Lagoon	15	0	4	0	0	0
Encinitas - SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon	0	0	2	0	0	0
Encinitas - LONG TRENCH; Double Tracking; crosses San Elijo Lagoon	21	0	0	0	0	0
Stations						
Solana Beach	Present	0	0	0	0	0
Del Mar (Solana Beach Station to I-5/805 Split)						
Alignments						
COVERED TRENCH on bluffs; crosses San Dieguito and Los Penasquitos Lagoons	60	0	21	3	0	0
TUNNEL under Camino Del Mar; crosses San Dieguito and Los Penasquitos Lagoons	61	0	0	3	0	0
TUNNEL along I-5; crosses San Dieguito and Los Penasquitos Lagoons	25	0	0	4	0	0

TABLE 4-1
Table 4-2
Detailed Analysis/Comparison Table
Impacts to Visual Resources
(Los Angeles - Orange County - San Diego)

Table 4-2 notes the potential impacts of the various alignment options on visual resources, including scenic corridors, viewpoints and overlooks, potential for high visual contrasts between the rail option and the surrounding environment, and the degree to which an option might create or increase shadow impacts.

	Scenic Corridors Impacted (miles) ¹	Scenic Viewing Points/Overlooks number within 1/4 miles (#)	High Contrast Impacts (H/M/L)	Shadow Impacts (H/M/L)
San Juan Capistrano (City Limits to Avenida Aeropuerto)				
Alignments				
Covered TRENCH/Cut-Fill between Trabuco Creek and Avenida Aeropuerto (trench goes under San Juan Creek); Double tracking	0	0	Low rail would be moved into covered and open trenches but would require new pedestrian overpasses downtown, and fencing along open trench areas	Low pedestrian overpasses would create new shadow effects in downtown area
TUNNEL along I-5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking	0	0	Beneficial Impact existing tracks would be removed into tunnel; new impacts would occur aqt tunnel portals but would be relatively minor	No Impact
AT-Grade/Open Trench along east side of Trabuco Creek	0	0	Medium New impacts to residential and commercial areas on west side of creek	Low proposed structure widening over San Juan Creek would increase shadow impacts but be consistent with existing environment
Stations				
San Juan Capistrano	0	0	Low proposed improvements to existing station would be consistent with existing environment	No Impact

1. There are no designated California State Scenic Routes in the visual resources study area for this project. While the existing LOSSAN rail corridor does provide views of the ocean and open spaces in some portions of its route, the established rail corridor itself is not considered a scenic corridor in the analysis represented in this table.

	Scenic Corridors Impacted (miles) ¹	Scenic Viewing Points/Overlooks number within 1/4 miles (#)	High Contrast Impacts (H/M/L)	Shadow Impacts (H/M/L)
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)				
Alignments				
Dana Point Curve Realignment; San Clemente - SHORT TRENCH; Double Tracking	0	0	High covered trench along coastline would reduce visibility of existing rail corridor, but construction along toe of bluffs would require seawalls that would degrade existing viewshed; major construction and transition structures on beach would impact visual environment	No Impact
Dana Point Curve Realignment; San Clemente - LONG TRENCH; Double Tracking	0	0	High covered trench along coastline would reduce visibility of existing rail corridor, but construction along toe of bluffs would require seawalls that would degrade existing viewshed; major construction on beach would impact visual environment	No Impact
Dana Point Curve Realignment; San Clemente - SHORT TUNNEL; Double Tracking	0	0	Beneficial Impact tunnel would remove existing rail along the coast and improve the existing beach aesthetics	No Impact
San Clemente - LONG ONE-SEGMENT TUNNEL; Double Tracking	0	0	Beneficial Impact tunnel would remove existing rail along the coast and improve the existing beach aesthetics	No Impact
San Clemente - LONG TWO-SEGMENT TUNNEL; Double Tracking	0	0	Beneficial Impact tunnel would remove existing rail along the coast and improve the existing beach aesthetics	No Impact

1. There are no designated California State Scenic Routes in the visual resources study area for this project. While the existing LOSSAN rail corridor does provide views of the ocean and open spaces in some portions of its route, the established rail corridor itself is not considered a scenic corridor in the analysis represented in this table.

	Scenic Corridors Impacted (miles) ¹	Scenic Viewing Points/Overlooks number within 1/4 miles (#)	High Contrast Impacts (H/M/L)	Shadow Impacts (H/M/L)
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)				
Alignments				
Encinitas - AT-GRADE; Double Tracking; crosses San Elijo Lagoon	0	0	Low proposed improvements would be consistent with existing environment	Low proposed grade separations and structure widening over lagoons would increase shadow impacts but would be consistent with existing environment
Encinitas - SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon	0	0	Beneficial Impact covered trench would place existing tracks underground in part of the existing corridor	Low proposed grade separations and structure widening over lagoons would increase shadow impacts but would be consistent with existing environment
Encinitas - LONG TRENCH; Double Tracking; crosses San Elijo Lagoon	0	0	Beneficial Impact covered trench would place existing tracks underground in part of the existing corridor	Low structure widening over lagoons would increase shadow impacts but would be consistent with existing environment
Solana Beach	0	0	Low proposed improvements at existing station would be consistent with existing environment	No impact

¹ There are no designated California State Scenic Routes in the visual resources study area for this project. While the existing LOSSAN rail corridor does provide views of the ocean and open spaces in some portions of its route, the established rail corridor itself is not considered a scenic corridor in the analysis represented in this table.

	Scenic Corridors Impacted (miles) ¹	Scenic Viewing Points/Overlooks number within 1/4 miles (#)	High Contrast Impacts (H/M/L)	Shadow Impacts (H/M/L)
Del Mar (Solana Beach Station to I-5/805 Split)				
Alignments				
COVERED TRENCH on bluffs; crosses San Dieguito and Los Penasquitos Lagoons	0	0	Medium to High trench option would remove existing tracks on the bluffs into a covered trench, but seawalls and/or tie-back walls may be needed to stabilize bluffs for the long term	Low proposed structure widening over lagoons would increase shadow impacts, but would be consistent with existing environment
TUNNEL under Camino Del Mar; crosses San Dieguito and Los Penasquitos Lagoons	0	0	Beneficial Impact tunnel option would remove existing tracks from the bluffs and place them underground	Low proposed structure widening over lagoons would increase shadow impacts, but would be consistent with existing environment
TUNNEL along I-5; crosses San Dieguito and Los Penasquitos Lagoons	0	0	Medium tunnel option would remove existing tracks and place underground, but new visual impacts to residential views would result from elevated rail structure south of San Dieguito Lagoon, and from tunnel portal/transition area located between two residential areas	Low tunnel option would remove existing structure across Penasquitos Lagoon, but structure over San Dieguito Lagoon would be widened, and elevated structure across Crest Canyon would add new shadow impacts

1. There are no designated California State Scenic Routes in the visual resources study area for this project. While the existing LOSSAN rail corridor does provide views of the ocean and open spaces in some portions of its route, the established rail corridor itself is not considered a scenic corridor in the analysis represented in this table.

TABLE 4-3
Detailed Analysis/Comparison Table
Impacts to Land Use, Planned Land Use and Land Use and Land Use Policy,
Development Patterns, Demographics, Communities and Neighborhoods, Housing & Economics
(Los Angeles-Orange County-San Diego Region)

As part of the evaluation of land uses, Table 4-3 summarizes compatibility issues for stations and alignments; Environmental Justice factors including the percentage of persons along the alignment option living below the federal Poverty Line (P) and the percent of minority population (M). The table also shows the number of residential housing units within ¼ mile of the alignment, as well as the total non-residential acreage within ¼ mile of the alignment.

		Environmental Justice Impacts (Percent of Population Under Poverty Line)	Environmental Justice Impacts (Percent of Minority Population - Block Group and County)	Number of Residential Units within ¼ mile of Alignment	Non-Residential Acreage within ¼ mile of Alignment
San Juan Capistrano (City Limits to Avenida Aeropuerto)					
Alignments					
Covered TRENCH/Cut-Fill between Trabuco Creek and Avenida Aeropuerto (trench goes under San Juan Creek); Double tracking	24.44%	BG = 8.92%; County = 7.74%	BG = 45.18% and County = 48.86%	18,725	368
TUNNEL along I- 5 between Hwy 73 and Avenida Aeropuerto (tunnel under Trabuco Creek and San Juan Creek); Double tracking	23.95%	BG = 8.92%; County = 7.74%	BG = 45.18% and County = 48.86%	14,120	393
AT-Grade/Open Trench along east side of Trabuco Creek	65.84%	BG = 11.06%; County = 7.74%	BG = 46.71%; County = 48.86%	11,676	101

	Percent of Residential Acreage ¹	Environmental Justice Impacts (Percent of Population Under Poverty Line)	Environmental Justice Impacts (Percent of Minority Population - Block Group and County)	Number of Residential Units within ¼ mile of Alignment	Non-Residential Acreage within ¼ mile of Alignment
Stations					
San Juan Capistrano	36.24%	BG = 8.14%; County = 7.74%	BG = 66.13% and County = 48.86%	1,487	8
Dana Point/San Clemente (Avenida Aeropuerto To San Onofre Power Plant)					
Alignments					
Dana Point Curve Realignment; San Clemente - SHORT TRENCH; Double Tracking (crosses San Mateo and San Onofre Creeks)	41.28%	BG = 6.57%; County = 7.74 and 10.34%	BG = 32.88% and County = 48.86 and 45.11%	42,184	340
Dana Point Curve Realignment; San Clemente - LONG TRENCH; Double Tracking (crosses San Mateo and San Onofre Creeks)	41.28%	BG = 6.57%; County = 7.74 and 10.34%	BG = 32.88% and County = 48.86 and 45.11%	42,184	617
Dana Point Curve Realignment; San Clemente - SHORT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	38.20%	BG = 6.57%; County = 7.74 and 10.34%	BG = 32.88% and County = 48.86 and 45.11%	45,068	617

	Percent of Residential Acreage ¹	Environmental Justice Impacts (Percent of Population Under Poverty Line)	Environmental Justice Impacts (Percent of Minority Population - Block Group and County)	Number of Residential Units within ¼ mile of Alignment	Non-Residential Acreage within ¼ mile of Alignment
San Clemente - LONG ONE-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	42.19%	BG = 6.57%; County = 7.74 and 10.34%	BG = 32.88% and County = 48.86 and 45.11%	50,003	560
San Clemente - LONG TWO-SEGMENT TUNNEL; Double Tracking (crosses San Mateo and San Onofre Creeks)	42.19%	BG = 6.57%; County = 7.74 and 10.34%	BG = 32.88% and County = 48.86 and 45.11%	50,003	560
Encinitas/Solana Beach (Encinitas City Limits to Solana Beach Station)					
Alignments					
Encinitas - AT-GRADE; Double Tracking; crosses San Elijo Lagoon	54.31%	BG = 6.77%; County = 10.34%	BG = 20.41% and County = 45.11%	12,342	237
Encinitas - SHORT TRENCH; Double Tracking; crosses San Elijo Lagoon	54.31%	BG = 6.77%; County = 10.34%	BG = 20.41% and County = 45.11%	12,342	237
Encinitas - LONG TRENCH; Double Tracking; crosses San Elijo Lagoon	54.31%	BG = 6.77%; County = 10.34%	BG = 20.41% and County = 45.11%	12,342	217

	Percent of Residential Acreage ¹	Environmental Justice Impacts (Percent of Population Under Poverty Line)	Environmental Justice Impacts (Percent of Minority Population - Block Group and County)	Number of Residential Units within ¼ mile of Alignment	Non-Residential Acreage within ¼ mile of Alignment
Stations					
Solana Beach	3.03%	BG = 3.55%; County = 10.34%	BG = 12.13% and County = 45.11%	1,609	6
Del Mar (Solana Beach Station to I-5/805 Split)					
Alignments					
COVERED TRENCH on bluffs; crosses San Dieguito and Los Penasquitos Lagoons	21.75%	BG = 6.11%; County = 10.34%	BG = 19.98% and County = 45.11%	16,031	256
TUNNEL under Camino Del Mar; crosses San Dieguito and Los Penasquitos Lagoons	27.77%	BG = 6.11%; County = 10.34%	BG = 19.98% and County = 45.11%	17,126	255
TUNNEL along I-5; crosses San Dieguito and Los Penasquitos Lagoons	52.75%	BG = County = 10.34%	BG = 21.56% County = 45.11%	14,228	324

Note:

1. Based on a 1/4-mile study area on either side of the rail or highway corridor. Potential property takes would be very limited due to the location of most alignments in or adjacent to the existing LOSSAN rail corridor. See Table 4-1A for information on expected land use impacts of property takes and access/barrier issues.

Table 4-3A
Potential Land Use Impacts on
Property and Community/Coastal Access

Table 4-3A summarizes the potential need in each alignment option to acquire land or easement agreements (some underground, for tunnel options), and how the options would affect access issues (such as creation or removal of a barrier between a residential community and a commercial/retail district, or between the coast and other areas.)

CITY SEGMENT	POTENTIAL PROPERTY/EASEMENT ACQUISITION	ACCESS
San Juan Capistrano	<ul style="list-style-type: none"> • Cut/cover option through downtown: <ul style="list-style-type: none"> ○ Industrial structures/land along San Juan Creek; parking structure and land in downtown area • Trabuco Creek option: <ul style="list-style-type: none"> ○ Commercial and industrial structures/land; private high school land; (City may be able to provide land exchanges) • I-5 tunnel option: <ul style="list-style-type: none"> ○ Land at portal areas ○ Industrial structures/land along San Juan Creek ○ Commercial/agricultural land at north end of alignment 	<ul style="list-style-type: none"> • All options improve access between the historic residential area of Los Rios and downtown area, however, Trabuco Creek and I-5 tunnel options offer the greatest benefit by completely removing the tracks from the downtown area
San Clemente	<ul style="list-style-type: none"> • Short trench option: <ul style="list-style-type: none"> ○ Land south of the pier for new station • Long trench option: <ul style="list-style-type: none"> ○ Residential land south of N. El Camino Real ○ Land south of the pier for new station • Short I-5 tunnel: <ul style="list-style-type: none"> ○ Commercial/residential land south of Avenida Pico ○ Vacant land at Avenida Pico for new station • Long I-5 tunnels: <ul style="list-style-type: none"> ○ Industrial land north of Stonehill Rd (San Juan Capistrano) 	<ul style="list-style-type: none"> • All options would improve access to the Pacific shoreline; however, the short trench option would involve transition structures on the beach, and both trench options would require major construction for an extended time period on the beach. The tunnel options offer the greatest benefit by the completely removing the tracks from the beach

CITY SEGMENT	POTENTIAL PROPERTY/EASEMENT ACQUISITION	ACCESS
Encinitas	<ul style="list-style-type: none"> • All options: <ul style="list-style-type: none"> ○ Commercial land in the vicinity of Leucadia Blvd and Pacific Coast Hwy 	<ul style="list-style-type: none"> • Short or Long trench option offers the best opportunity for frequent pedestrian crossings connecting commercial and residential land uses
Del Mar	<ul style="list-style-type: none"> • Trench in bluffs: <ul style="list-style-type: none"> ○ Land in the vicinity of Jimmy Durante Blvd and Camino Del Mar • Camino Del Mar tunnel: <ul style="list-style-type: none"> ○ Vacant land in the vicinity of Torrey Pines Rd and LOSSAN Corridor • Penasquitos Lagoon bypass tunnel: <ul style="list-style-type: none"> ○ Industrial land along Sorrento Valley Rd ○ Residential land along south side of San Diequito Lagoon 	<ul style="list-style-type: none"> • Camino Del Mar tunnel and Penasquitos Lagoon bypass options improve access to the shoreline by completely removing the tracks from the bluffs